PROJECT FACT SHEET

CONTRACT TITLE: Extending Borehole Electromagnetic Imaging to Cased Wells (PARTNERSHIP)

ID NUMBER: P-23

B&R CODE: AC1005000

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PROJECT SITE
CITY: Berkeley **STATE:** CA
CITY: Livermore **STATE:** CA
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CONTRACT PERFORMANCE PERIOD:
10/1/1994 to 9/30/1999

PROGRAM: Supporting Research
RESEARCH AREA: Partnership/Oil Recovery Technology
PRODUCT LINE: ADIS

FUNDING (1000'S)	DOE	CONTRACTOR	TOTAL
PRIOR FISCAL YRS	1000	345	1345
FISCAL YR 1999	36	90	126
FUTURE FUNDS	0	0	0
TOTAL EST'D FUNDS	1036	435	1471

OBJECTIVE: To extend borehole electromagnetic (EM) imaging to steel cased wells.

PROJECT DESCRIPTION:

Background: The goal of this project is to use electromagnetic (EM) imaging in steel cased wells.

The work involved in this project is driven by the Industry Consortium of Chevron, Halliburton, JNOC, OYO Geospace, Baker Atlas, EMI, LBNL, and LLNL. The joint Industry/LBL/LLNL consortium was formed with the objective of testing and developing surface electrical and EM methods. Specifically, these objectives were multifrequency crosshole EM tomography in the range of 1 to 100 kHz, long spacing single hole induction logs, and measurements through steel casing. The first objective has been successfully conducted and concluded. The highlights of the achievements are that we can accurately make crosshole measurements and the high-resolution imaging of electrical conductivity can be done using these measurements. With the additional support of this program, we should be able to accomplish the measurements-through-casing objectives.

Work to be Performed: The proposed work in the first year of the second phase consists of three tasks. Task 1 - Fabricate borehole EM Device for Casing Parameter. Small loops may be used as the transmitter and the receiver separated by a small distance. A co-incident time-domain device could be considered for this purpose. Due to reduced budget, Task 1 will not be carried out this year. Task 2 - Develop Numerical Codes: Two codes will be developed. One is the finite element modeling code to simulate segmented casing in a simple medium of cylindrically symmetric conductivity structures. The problem is scalar if we formulate it using the azimuthal electric field, even if the casing is both electrically conductive and magnetically permeable. The second is the casing parameter analysis packaged using data obtained from Task 1. Task 3 - Improve Field Measurement Techniques: A key to success of the cased borehole EM is the accuracy of the measurement. To this end, we will improve field techniques by collecting field data, determining noise and sensitivity levels within steel casing, and testing hardware and software tools as they are developed.

PROJECT STATUS:

Current Work: Work is progressing according to the schedule except for the delay in the completion of the segmented casing analysis. 1999 funding of $36K is the final funding for this project.

Scheduled Milestones:

Complete sensitivity analysis of the proposed casing tool	09/98
Continue field measurement with one hole steel cased	09/98
Annual Report	09/98
Complete software package development for segmented casing	03/00

Accomplishments: The system has been successfully upgraded by increasing the transmitter moment to 3000 A-m*m with improved electronics (EMI). Collected data is repeatable from 1% up to 200 Hz. One major accomplishment from the field test was that data could be obtained even when both boreholes are steel cased. The data quality is excellent for frequencies of 24 and 48 Hertz.

Using the improved EM modeling code for analyzing EM fields in cased boreholes, a conceptual design of a borehole tool for extracting casing parameters has been developed (last period). The technique involves EM measurements just a few inches from the transmitter in the frequency domain. In the time domain one can use single loop as both the transmitter and the receiver. Using the proposed tool one can resolve individual casing parameters within 0.1% accuracy if the data is better than 10 PPM.